

REMARKS

With the cancellation of claims 24 and 27, claims 21 to 23, 25 to 26, 28 to 32 and 34 to 40 are now pending in the present application. Claims 21, 25 and 29 have been amended. Applicants respectfully submit that the pending claims are patentable for the following reasons.

I. Rejection of Claims 21 to 27, 29 to 32, 37 and 40

Claims 21 to 27, 29 to 32, 37 and 40 were rejected under 35 U.S.C. §103(a) as allegedly being unpatentable over United States Patent No. 6,051,503 ("Bhardwaj et al.") in view of United States Patent No. 6,277,173 ("Sadakata et al."). It is respectfully submitted that the combination of Bhardwaj et al. and Sadakata et al. does not render these claims unpatentable for the following reasons.

Claim 21 relates to a method for anisotropically etching structures into a substrate positioned in an etching chamber, comprising: providing an etching mask on a silicon substrate positioned in the etching chamber; and providing the etching chamber at least intermittently with an etching gas and at least intermittently with a passivation gas, wherein the passivation gas is supplied to the etching chamber in cycles each having a time period between 0.05 second and 1 second.

Claim 21 has now been amended to include the features of claims 24 and 27. Accordingly, claims 24 and 27 have been canceled, and claims 25 and 29, which both depend from claim 24, have now been amended to depend from claim 21. Claim 21, as amended, recites that the etching gas and the passivation gas are used alternately during separate etching steps and passivation steps that are controlled independently of one another, the passivation gas being supplied to the etching chamber substantially only during the passivation steps, and the etching gas being supplied to the etching chamber substantially only during the etching steps; and that the duration of the passivation steps is set to be shorter than the duration of the etching steps by a factor of 10 to 30.

Neither Bhardwaj et al., nor Sadakata et al. disclose or suggest that the duration of passivation steps is set to be shorter than the duration of etching steps by a factor of 10 to 30, i.e., at least one order of magnitude. Bhardwaj

et al. do state, in column 10, lines 19 to 22, that it is desirable to limit the etch and deposition periods to less than 7.5 seconds. However, no mention is made of the ratio of etching-step to passivation-step durations.

Furthermore, neither Bhardwaj et al., nor Sadakata et al. provide a motivation to set the duration of the passivation steps to be shorter than the duration of the etching steps by a factor of 10 to 30, i.e., at least one order of magnitude. As stated in column 6, lines 50 to 67 of Bhardwaj et al., typical process parameters include etching and deposition steps of 2 to 15 seconds, and preferably 4 to 6 seconds. In addition, concrete examples from Figures 19(a) and 19(b) of Bhardwaj et al. provide for an etching phase of 13 seconds or 12 seconds and a passivation phase of 7 seconds. Thus, in contrast to the above-mentioned feature of claim 21 as amended, the passivation phases and the etching phases in Figures 19(a) and 19(b) of Bhardwaj et al. differ by a factor of less than two and are in the same order of magnitude.

Finally, the passivation durations of all the examples listed in Bhardwaj et al. are greater than one second, whereas one feature of claim 21, as amended, requires that the passivation gas be supplied to the etching chamber in cycles each having a time period between 0.05 second and 1 second. Accordingly, it is respectfully submitted that claim 21 as amended is allowable.

Claims 24 and 27 have been canceled, thereby rendering moot this rejection with respect to these claims.

As for claims 22 to 23, 25 to 26 and 28 to 29, which ultimately depend from claim 21 and therefore include all of the features recited in claim 21, it is respectfully submitted that the combination of Bhardwaj et al. and Sadakata et al. does not render these dependent claims unpatentable for at least the same reasons more fully set forth above in support of the patentability of claim 21.

As regards claims 26 and 29, it is respectfully submitted that the combination of Bhardwaj et al. and Sadakata et al. does not render these claims unpatentable for at least the following additional reasons.

As regards claim 26, Bhardwaj et al. disclose the use of H-C films as passivation layers (see column 5, lines 43-47). However, Teflon® (polytetrafluoroethylene) is not a hydrocarbon polymer, but rather a fluoropolymer of the formula $(C_2F_4)_n$, and has unique properties such as a low

coefficient of friction, high dielectric strength, high degree of chemical inertness, etc. Thus, it is respectfully submitted that one skilled in the art would be familiar with the term "Teflon®-like," and that the H-C films of Bhardwaj et al. are not Teflon®-like polymers. Consequently, the combination of Bhardwaj et al. and Sadakata et al. does not render this claim unpatentable for these additional reasons.

As regards claim 29, contrary to the contention made on page 3, lines 10-11 of the Office Action, neither Bhardwaj et al., nor Sadakata et al. disclose or suggest that the amount of the passivation gas used during each of the individual passivation steps is reduced one of continuously and in steps as etching progresses. Bhardwaj et al. disclose that the chamber pressure may be reduced and/or the flow rate increased, but are silent about the amount of passivation gas used during each passivation step (see column 2, lines 29-32 of Bhardwaj et al.). It is, therefore, respectfully submitted that the combination of Bhardwaj et al. and Sadakata et al. does not render this claim unpatentable for these additional reasons.

Claim 30 relates to a plasma system for anisotropically etching structures into a substrate, comprising: an etching chamber for accommodating the substrate, wherein the substrate is positioned on a substrate electrode located within the etching chamber; a plasma source for producing a plasma acting on the substrate; a supply arrangement for at least intermittently supplying an etching gas and at least intermittently supplying a passivation gas to the etching chamber; a passivation gas line provided upstream from the etching chamber; a buffer tank located along the passivation gas line upstream from the etching chamber; and a passivation gas valve located downstream from the buffer tank and upstream from the etching chamber.

Neither Bhardwaj et al., nor Sadakata et al. disclose or suggest a buffer tank located along the passivation gas line upstream from the etching chamber and a passivation gas valve located downstream from the buffer tank and upstream from the etching chamber. Sadakata et al. do describe a buffer tank and associated valves. However, the buffer tank of Sadakata et al. is not located along a passivation gas line, but along a line dedicated to

starting gas and gases recycled after passing through a detoxification unit in an exhaust line of a manufacturing apparatus.

In addition, the motivation provided on page 3, lines 21 to 22 of the Office action, for employing the buffer tank and gas valves of Sadakata et al. in the reactor of Bhardwaj et al. - namely, to regulate the concentration of gas into a process chamber during etching - is invalid. In Sadakata et al., the buffer tank does help to adjust the concentration of gas entering a process chamber. However, the buffer tank is needed in Sadakata et al. because the gas is supplied by at least one source, in this case an exhaust line of a detoxification unit, which does not necessarily provide the gas at a known or constant concentration. Therefore, a buffer tank is needed to adjust this concentration. However, in the reactor of Bhardwaj et al., there is no indication that any source of process gases is providing these gases at a concentration that is unknown or fluctuating. Therefore, it is respectfully submitted that the regulation of the concentration of gas into a process chamber is not a proper motivation for combining the teachings of Bhardwaj et al. and Sadakata et al.

In contrast, the buffer tank (24) of the present Application is present in the passivation gas line, in order to rapidly discharge passivation gas into the etching chamber (12) in a manner not readily possible using conventional mass flow controllers and valves, due to mechanical inertia. The buffer tank (24) allows for very brief passivation steps of 0.05 seconds to 1 second, so that a high ratio of etching duration to passivation duration of 10 to 30 may be achieved.

Accordingly, it is respectfully submitted that claim 30 as amended is allowable.

As for claims 31, 32, 37 and 40, which ultimately depend from claim 30 and therefore include all of the features recited in claim 30, it is respectfully submitted that the combination of Bhardwaj et al. and Sadakata et al. does not render these dependent claims unpatentable for at least the same reasons more fully set forth above in support of the patentability of claim 30.

In view of all of the foregoing, withdrawal of this rejection is respectfully requested.

II. Rejection of Claim 28

Claim 28 was rejected under 35 U.S.C. §103(a) as allegedly being unpatentable over Bhardwaj et al. in view of Sadakata et al. and U.S. Patent Application Publication No. 2003/0059720 ("Hwang et al."). It is respectfully submitted that the combination of Bhardwaj et al., Sadakata et al. and Hwang et al. does not render this claim unpatentable for the following reasons.

Claim 28 ultimately depends from claim 21 and therefore includes all of the features recited in claim 21. In addition, Hwang et al. do not disclose or suggest all of the features of claim 21 not disclosed or suggested by Bhardwaj et al. and Sadakata et al. Therefore, it is respectfully submitted that the combination of Bhardwaj et al., Sadakata et al. and Hwang et al. does not render this dependent claim unpatentable for at least these reasons and the reasons more fully set forth above in support of the patentability of claim 21.

In view of all of the above, withdrawal of this rejection is respectfully requested.

III. Rejection of Claims 34 to 36

Claims 34 to 36 were rejected under 35 U.S.C. §103(a) as allegedly being unpatentable over Bhardwaj et al. in view of Sadakata et al. and United States Patent No. 6,846,745 ("Papasouliotis et al."). It is respectfully submitted that the combination of Bhardwaj et al., Sadakata et al. and Papasouliotis et al. does not render these claims unpatentable for the following reasons.

Claims 34 to 36 ultimately depend from claim 30 and therefore include all of the features recited in claim 30. In addition, Papasouliotis et al. do not disclose or suggest all of the features of claim 30 not disclosed or suggested by Bhardwaj et al. and Sadakata et al. Therefore, it is respectfully submitted that the combination of Bhardwaj et al., Sadakata et al. and Papasouliotis et al. does not render these dependent claims unpatentable for at least these reasons and the reasons more fully set forth above in support of the patentability of claim 30.

In view of all of the above, withdrawal of this rejection is respectfully requested.

IV. Rejection of Claims 38 and 39

Claims 38 and 39 were rejected under 35 U.S.C. §103(a) as allegedly being unpatentable over Bhardwaj et al. in view of Sadakata et al. and United States Patent No. 5,683,548 ("Hartig et al."). It is respectfully submitted that the combination of Bhardwaj et al., Sadakata et al. and Hartig et al. does not render these claims unpatentable for the following reasons.

Claims 38 and 39 ultimately depend from claim 30 and therefore include all of the features recited in claim 30. In addition, Hartig et al. do not disclose or suggest all of the features of claim 30 not disclosed or suggested by Bhardwaj et al. and Sadakata et al. Therefore, it is respectfully submitted that the combination of Bhardwaj et al., Sadakata et al. and Hartig et al. does not render these dependent claims unpatentable for at least these reasons and the reasons more fully set forth above in support of the patentability of claim 30.

As regards claims 38 and 39, it is respectfully submitted that the combination of Bhardwaj et al., Sadakata et al. and Hartig et al. does not render these claims unpatentable for at least the following additional reasons.

As regards claim 38, neither Bhardwaj et al., nor Sadakata et al., nor Hartig et al. disclose or suggest that a power per area of more than 5 watts/cm² is provided inside the etching chamber in one of the region near the plasma source and at a location of the substrate. This value of power per unit area is advantageous in that it renders the plasma particularly tolerant to process parameter fluctuations. It is, therefore, respectfully submitted that the combination of Bhardwaj et al., Sadakata et al. and Hartig et al. does not render this claim unpatentable for these additional reasons.

As regards claim 39, neither Bhardwaj et al., nor Sadakata et al., nor Hartig et al. disclose or suggest that the currents in coils (54) and (56) of Hartig et al. flow in opposite directions. It is, therefore, respectfully submitted that the combination of Bhardwaj et al., Sadakata et al. and Hartig et al. does not render this claim unpatentable for these additional reasons.

In view of all of the above, withdrawal of this rejection is respectfully requested.

V. Conclusion

In view of the foregoing, it is respectfully submitted that all pending claims of the present application are now in condition for allowance. Prompt reconsideration and allowance of the present application are therefore earnestly solicited.

Respectfully submitted,

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